Questions & Answers about . . .

Avascular Necrosis

National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)
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National Institute of Arthritis and Musculoskeletal and Skin Diseases
NIAMS/National Institutes of Health
1 AMS Circle
Bethesda, MD 20892–3675

You can also find this booklet on the NIAMS Web site at www.niams.nih.gov/hi/topics/avascular_necrosis/index.htm.

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What Is Avascular Necrosis?

Avascular necrosis is a disease resulting from the temporary or permanent loss of the blood supply to the bones. Without blood, the bone tissue dies and causes the bone to collapse. If the process involves the bones near a joint, it often leads to collapse of the joint surface. This disease also is known as osteonecrosis, aseptic necrosis, and ischemic bone necrosis.

Although it can happen in any bone, avascular necrosis most commonly affects the ends (epiphysis) of long bones such as the femur, the bone extending from the knee joint to the hip joint. Other common sites include the upper arm bone, knees, shoulders, and ankles. The disease may affect just one bone, more than one bone at the same time, or more than one bone at different times. Avascular necrosis usually affects people between 30 and 50 years of age; about 10,000 to 20,000 people develop avascular necrosis each year. Orthopaedic doctors most often diagnose the disease.

The amount of disability that results from avascular necrosis depends on what part of the bone is affected, how large an area is involved, and how effectively the bone rebuilds itself. The process of bone rebuilding takes place after an injury as well as during normal growth. Normally, bone continuously breaks down and rebuilds—old bone is reabsorbed and replaced with new bone. The process keeps the skeleton strong and helps it to maintain a balance of minerals. In the course of avascular necrosis, however, the healing process is usually ineffective and the bone tissues break down faster

than the body can repair them. If left untreated, the disease progresses, the bone collapses, and the joint surface breaks down, leading to pain and arthritis.

What Causes Avascular Necrosis?

Avascular necrosis has several causes. Loss of blood supply to the bone can be caused by an injury (trauma-related avascular necrosis or joint dislocation) or by certain risk factors (nontraumatic avascular necrosis), such as some medications (steroids), blood coagulation disorders, or excessive alcohol use. Increased pressure within the bone also is associated with avascular necrosis. The pressure within the bone causes the blood vessels to narrow, making it hard for the vessels to deliver enough blood to the bone cells.

Injury

When a joint is injured, as in a fracture or dislocation, the blood vessels may be damaged. This can interfere with the blood circulation to the bone and lead to trauma-related avascular necrosis. Studies suggest that this type of avascular necrosis may develop in more than 20 percent of people who dislocate their hip joint.

Steroid Medications

Corticosteroids such as prednisone are commonly used to treat diseases in which there is inflammation, such as systemic lupus erythematosus, rheumatoid arthritis, inflammatory bowel disease, and vasculitis. Studies suggest that long-term, systemic (oral or intravenous) corticosteroid use is associated with 35 percent of all cases of nontraumatic avascular necrosis. However, there is no known risk of avascular necrosis associated with the limited use of steroids. Patients should discuss concerns about steroid use with their doctor.

Doctors aren't sure exactly why the use of corticosteroids sometimes leads to avascular necrosis. They may interfere with the body's ability to break down fatty substances. These substances then build up in and clog the blood vessels, causing them to narrow. This reduces the amount of blood that gets to the bone. Some studies suggest that corticosteroid-related avascular necrosis is more severe and more likely to affect both hips (when occurring in the hip) than avascular necrosis resulting from other causes.

Alcohol Use

Excessive alcohol use and corticosteroid use are two of the most common causes of nontraumatic avascular necrosis. In people who drink an excessive amount of alcohol, fatty substances may block blood vessels, causing a decreased blood supply to the bones that results in avascular necrosis.

Other Risk Factors

Other risk factors or conditions associated with nontraumatic avascular necrosis include Gaucher's disease, pancreatitis, radiation treatments and chemotherapy, decompression disease, and blood disorders such as sickle cell disease.

Who Is Likely To Develop Avascular Necrosis?

Avascular necrosis affects both men and women and affects people of all ages. It is most common among people in their thirties and forties. Depending on a person's risk factors and whether the underlying cause is trauma, it also can affect younger or older people.

What Are the Symptoms?

In the early stages of avascular necrosis, patients may not have any symptoms. As the disease progresses, however, most patients experience joint pain—at first, only when putting weight on the affected joint, and then even when resting. Pain usually develops gradually and may be mild or severe. If avascular necrosis progresses and the bone and surrounding joint surface collapse, pain may develop or increase dramatically. Pain may be severe enough to limit the patient's range of motion in the affected joint. In some cases, particularly those involving the hip, disabling osteoarthritis may develop. The period of time between the

first symptoms and loss of joint function is different for each patient, ranging from several months to more than a year.

How Is Avascular Necrosis Diagnosed?

After performing a complete physical examination and asking about the patient's medical history (for example, what health problems the patient has had and for how long), the doctor may use one or more imaging techniques to diagnose avascular necrosis. As with many other diseases, early diagnosis increases the chances of treatment success.

It is likely that the doctor first will recommend a radiograph, commonly called an x ray. X rays can help identify many causes of joint pain, such as a fracture or arthritis. If the x ray is normal, the patient may need to have more tests. Research studies have shown that magnetic resonance imaging, or MRI, is the most sensitive method for diagnosing avascular necrosis in the early stages. The tests described below may be used to determine the amount of bone affected and how far the disease has progressed.

X Ray

An x ray is a common tool that the doctor may use to help diagnose the cause of joint pain. It is a simple way to produce pictures of bones. The x ray of a person with early avascular necrosis is likely to be normal because x rays are not sensitive enough to detect the bone changes in the early

stages of the disease. X rays can show bone damage in the later stages, and once the diagnosis is made, they are often used to monitor the course of the condition.

Magnetic Resonance Imaging (MRI)

MRI is quickly becoming a common method for diagnosing avascular necrosis. Unlike x rays, bone scans, and CT (computed/computerized tomography) scans, MRI detects chemical changes in the bone marrow and can show avascular necrosis in its earliest stages. MRI provides the doctor with a picture of the area affected and the bone rebuilding process. In addition, MRI may show diseased areas that are not yet causing any symptoms.

Bone Scan

Also known as bone scintigraphy, bone scans are used most commonly in patients who have normal x rays. A harmless radioactive dye is injected into the affected bone and a picture of the bone is taken with a special camera. The picture shows how the dye travels through the bone and where normal bone formation is occurring. A single bone scan finds all areas in the body that are affected, thus reducing the need to expose the patient to more radiation. Bone scans do not detect avascular necrosis at the earliest stages.

Computed/Computerized Tomography

A CT scan is an imaging technique that provides the doctor with a three-dimensional picture of the bone. It also shows "slices" of the bone, making the picture much clearer than x rays and bone scans. Some doctors disagree about the usefulness of this test to diagnose avascular necrosis. Although a diagnosis usually can be made without a CT scan, the technique may be useful in determining the extent of bone damage.

Biopsy

A biopsy is a surgical procedure in which tissue from the affected bone is removed and studied. Although a biopsy is a conclusive way to diagnose avascular necrosis, it is rarely used because it requires surgery.

Functional Evaluation of Bone

Tests to measure the pressure inside a bone may be used when the doctor strongly suspects that a patient has avascular necrosis, despite normal results of x rays, bone scans, and MRIs. These tests are very sensitive for detecting increased pressure within the bone, but they require surgery.

What Treatments Are Available?

Appropriate treatment for avascular necrosis is necessary to keep joints from breaking down. If untreated, most patients will experience severe pain and limitation in movement within 2 years.

Several treatments are available that can help prevent further bone and joint damage and reduce pain. To determine the most appropriate treatment, the doctor considers the following aspects of a patient's disease:

- The age of the patient
- The stage of the disease—early or late
- The location and amount of bone affected—a small or large area
- The underlying cause of avascular necrosis—with an ongoing cause such as corticosteroid or alcohol use, treatment may not work unless use of the substance is stopped.

The goal in treating avascular necrosis is to improve the patient's use of the affected joint, stop further damage to the bone, and ensure bone and joint survival. To reach these goals, the doctor may use one or more of the following treatments.

Conservative Treatment

- **Medicines**—to reduce fatty substances (lipids) that increase with corticosteroid treatment or to reduce blood clotting in the presence of clotting disorders. Nonsteroidal anti-inflammatory drugs may also be prescribed to reduce pain.

- **Reduced weight bearing**—If avascular necrosis is diagnosed early, the doctor may begin treatment by having the patient remove weight from the affected joint. The doctor may recommend limiting activities or using crutches. In some cases, reduced weight bearing can slow the damage caused by avascular necrosis and permit natural healing. When combined with medication to reduce pain, reduced weight bearing can be an effective way to avoid or delay surgery for some patients.

- **Range-of-motion exercises**—may be prescribed to maintain or improve joint range of motion.

- **Electrical stimulation**—to induce bone growth.

Conservative treatments have been used experimentally alone or in combination. However, these treatments rarely provide lasting improvement. Therefore, most patients will eventually need surgery to repair the joint permanently.

Surgical Treatment

- **Core decompression**—This surgical procedure removes the inner layer of bone, which reduces pressure within the bone, increases blood flow to the bone, and allows more blood vessels to form. Core decompression works best in people who are in the earliest stages of avascular necrosis, often before the collapse of the joint. This procedure sometimes can reduce pain and slow the progression of bone and joint destruction in these patients.

- **Osteotomy**—This surgical procedure reshapes the bone to reduce stress on the affected area. There is a lengthy recovery period, and the patient's activities are very limited for 3 to 12 months after an osteotomy. This procedure is most effective for patients with advanced avascular necrosis and those with a large area of affected bone.

- **Bone graft**—A bone graft may be used to support a joint after core decompression. Bone grafting is surgery that transplants healthy bone from one part of the patient, such as the leg, to the diseased area. Commonly, grafts (called vascular grafts) that include an artery and veins are used to increase the blood supply to the affected area. There is a lengthy recovery period after a bone graft, usually from 6 to 12 months. This procedure is complex and its effective-

ness is not yet proven. Clinical studies are under way to determine its effectiveness.

- **Arthroplasty/total joint replacement**—Total joint replacement is the treatment of choice in late-stage avascular necrosis and when the joint is destroyed. In this surgery, the diseased joint is replaced with artificial parts. It may be recommended for people who are not good candidates for other treatments, such as patients who do not do well with repeated attempts to preserve the joint. Various types of replacements are available, and people should discuss specific needs with their doctor.

For most people with avascular necrosis, treatment is an ongoing process. Doctors may first recommend the least complex and invasive procedure, such as protecting the joint by limiting movement, and watch the effect on the patient's condition. Other treatments then may be used to prevent further bone destruction and reduce pain. It is important that patients carefully follow instructions about activity limitations and work closely with their doctor to ensure that appropriate treatments are used.

What Research Is Being Done To Help People With Avascular Necrosis?

With proper treatment, most people with avascular necrosis can lead productive lives. But there is still a lot to learn about prevention, diagnosis, and treatment. For example, researchers are studying:

- New ways to diagnose avascular necrosis in its earliest stages, when nonsurgical treatment is most likely to help.
- The various causes of avascular necrosis so that, someday, it may be possible to prevent the disease.
- New treatments and improvement of the treatments that are available. In the future, medication may be an effective treatment for avascular necrosis.
- Improvements to the various types of hip replacements, to prevent younger patients from needing more than one hip replacement during their life.

Where Can People Find More Information About Avascular Necrosis?

- **National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)**
  National Institutes of Health
  1 AMS Circle
  Bethesda, MD 20892–3675
  Phone: 301–495–4484 or
  877–22–NIAMS (226–4267) (free of charge)
  TTY: 301–565–2966
  Fax: 301–718–6366
  E-mail: NIAMSInfo@mail.nih.gov
  www.niams.nih.gov

  NIAMS provides information about various forms of arthritis and rheumatic disease and bone, muscle, joint, and skin diseases. It distributes patient and professional education materials and refers people to other sources of information. Additional information and updates can also be found on the NIAMS Web site.

- **American Academy of Orthopaedic Surgeons**
  P.O. Box 2058
  Des Plaines, IL 60017
  Phone: 800–824–BONE (2663) (free of charge)
  www.aaos.org

  The academy publishes brochures on total joint replacement, arthritis, arthroscopy, and other subjects. Single copies of a brochure are available free of charge by sending a self-addressed, stamped (business-size) envelope to (*name of brochure*) at the address above.

- **Arthritis Foundation**
  1330 West Peachtree Street
  Atlanta, GA 30309
  Phone: 404–872–7100 or 800–283–7800 (free of charge)
  or call your local chapter (listed in the telephone directory)
  www.arthritis.org

  This is the main voluntary organization devoted to providing information and services to people affected by arthritis, rheumatic diseases, and related conditions.

- **The Hip Society**
  951 Old Country Road, #182
  Belmont, CA 94002
  Phone: 650–596–6190
  Fax: 650–508–2039

  This society maintains a list of physicians who are specialists in problems of the hip and provides physician referrals by geographic area.

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The mission of the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), a part of the National Institutes of Health (NIH), is to support research into the causes, treatment, and prevention of arthritis and musculoskeletal and skin diseases, the training of basic and clinical scientists to carry out this research, and the dissemination of information on research progress in these diseases. The National Institute of Arthritis and Musculoskeletal and Skin Diseases Information Clearinghouse is a public service sponsored by the NIAMS that provides health information and information sources. Additional information can be found on the NIAMS Web site at www.niams.nih.gov.

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